Bioaccumulation Model Updates in Response to EPA Comments

Bioaccumulation Model Meeting

December 7, 2017

620519

Overview of Topics

- Overview and Timeline
- Key model updates
  - River segmentation
  - Benthic invertebrate model compartments
  - Diets for upper trophic level species
  - Removal of particulate ventilation rate for carp
  - Calibration process
  - Sensitivity analysis
  - Other minor updatesb
- Other topics
  - Peer review
  - Newark Bay
  - Schedule

Timeline

June 2015	Draft report to EPA.
April 2016	Comments received from EPA.
August 2016	Meeting with EPA to discuss model changes.
August 2016 to present	Implement changes requested by EPA.
Next step	Calibration begins once EPA-approved, calibrated CFT model results are received.

Key Model Updates

River Segmentation

- **EPA comments**: Recalibrate model using multiple sediment bins to allow for refinement of each calibrated organism (e.g., EPA comment 577).
- **Model updates**:
  - Old model – Sitewide, RM 4-17.4, and RM 7-17.4
  - Revised model – RM 0-6, RM 6-14, and RM 14-17.4
- **Rationale**:
  - Segments based on physical characteristics (e.g., salinity), catch data, and concentration gradients.
  - As discussed in August 2016 meeting with EPA.
- Considering changing RM 14 boundary to RM 14.7. Is EPA ok with this?

River Segmentation (continued…)

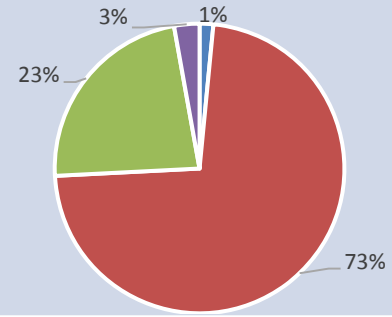
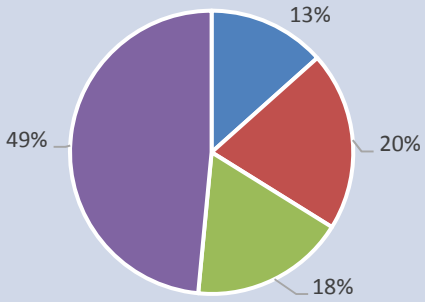
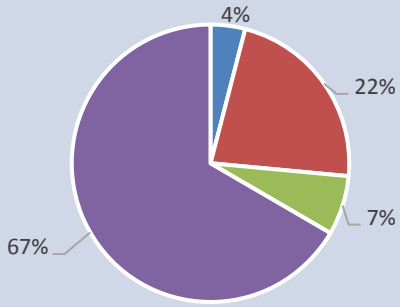
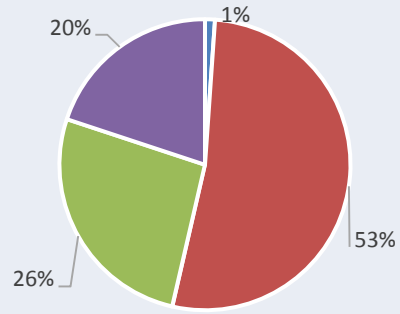
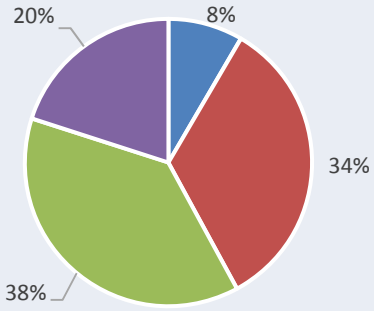
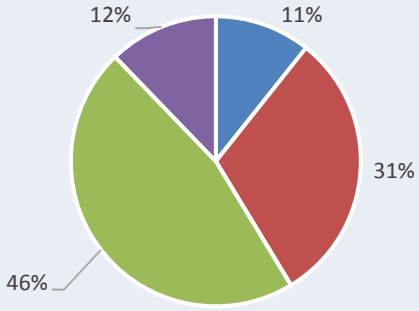
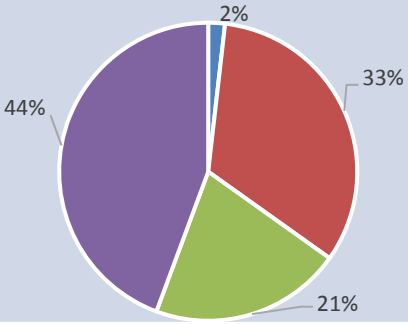
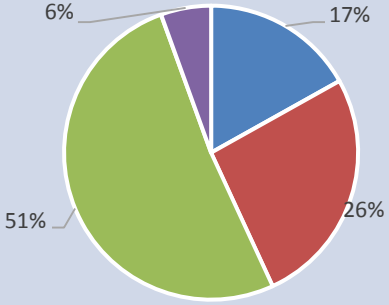
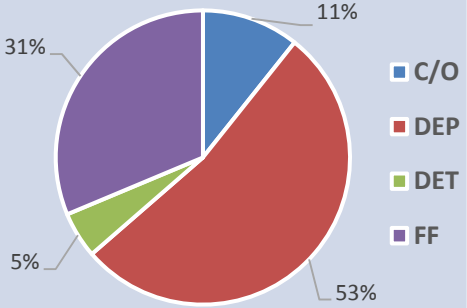
- Evaluated presence or absence of modeled species/groups in each modeling area.
  - Most present throughout LPRSA
  - Carp and bass are exception
- Some fish caught near segment boundaries included in multiple areas.

Species / Groups	RM 0-6	RM 6-14	RM 14-17.4
Filter feeding fish	✓	✓	✓
Small forage fish	✓	✓	✓
Small American eel (< 50 cm)	✓	✓	✓
Blue crab	✓	✓	✓
Carp		✓	✓
Catfish	✓	✓	✓
White perch	✓	✓	✓
Large American eel (>50 cm)	✓	✓	✓
Bass		✓	✓

Benthic Invertebrates:
Invertebrate categorization and biomass

- **EPA comment** – Add filter feeder group and re-categorize invertebrates based on information provided by EPA (e.g., EPA comment 573).
- **Model revisions**:
  - Updated biomass estimates
  - Updated model parameters for each group

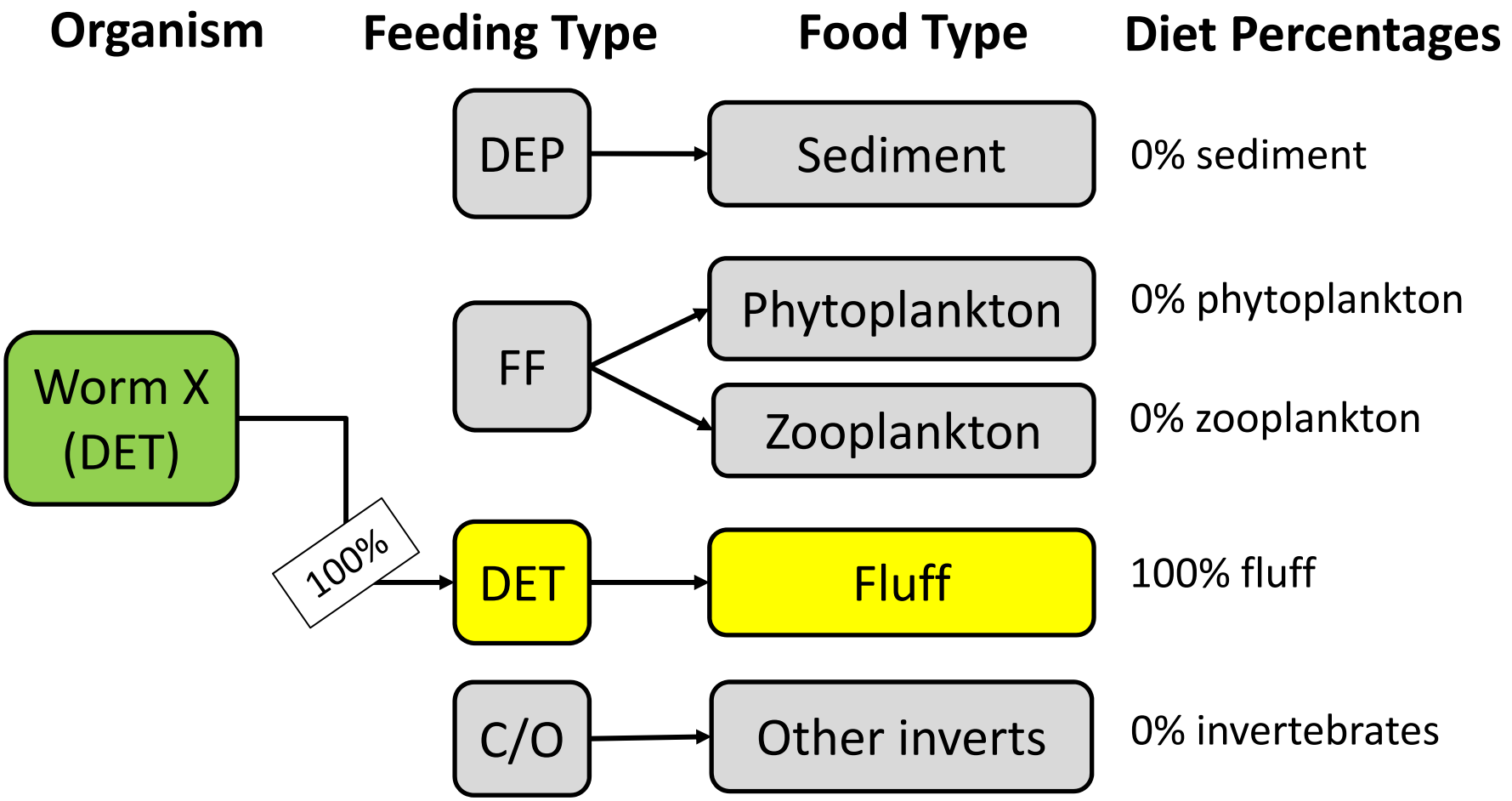
Benthic Invertebrates:
Invertebrate categorization and biomass

Season	RM 0 to RM 6	RM 6 to RM 14	RM 14 to RM 17.4
Fall 2009			
Spring 2010			
Summer 2010			

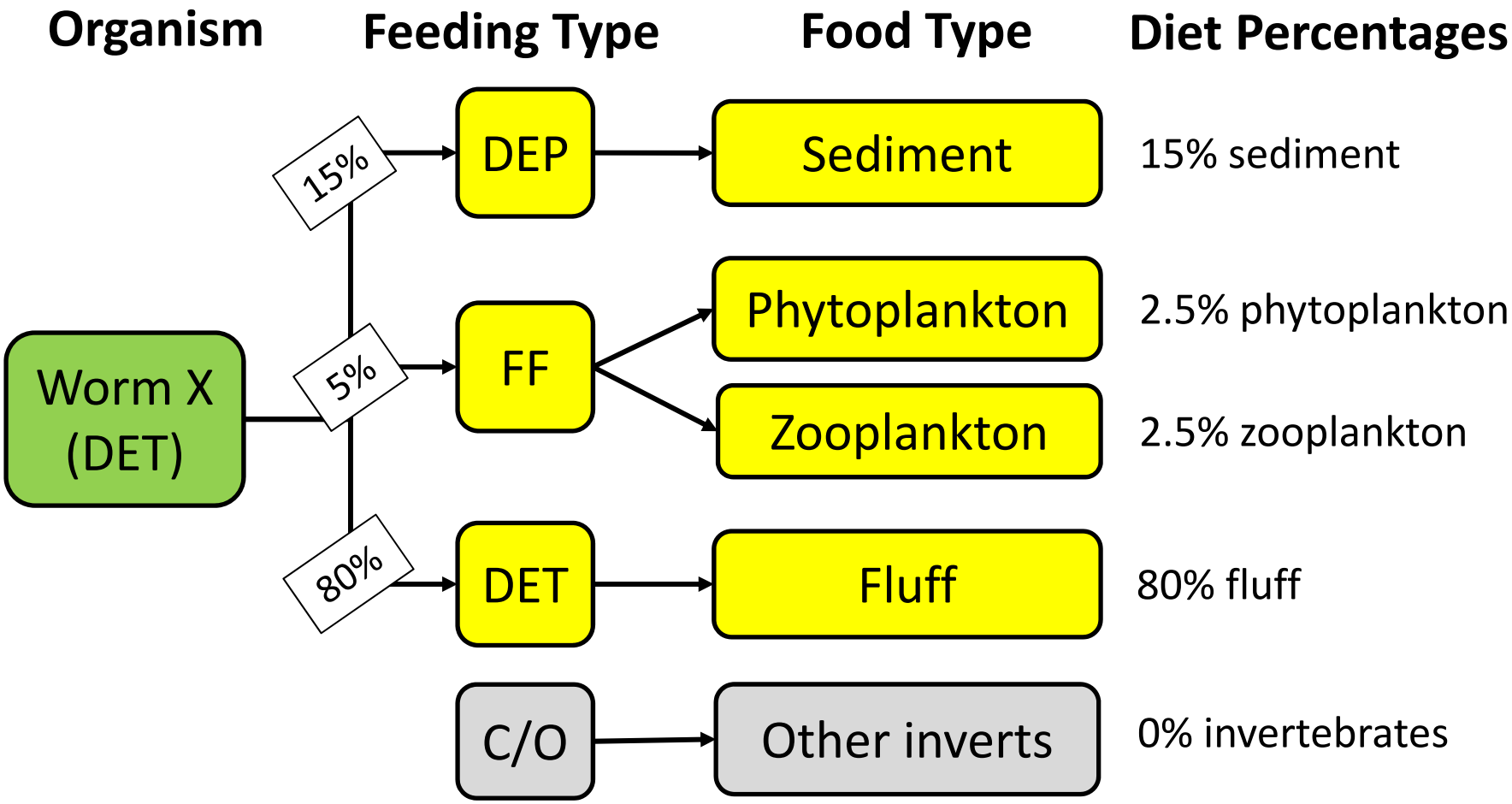
Benthic Invertebrates:
Accounting for feeding plasticity in diets

- **EPA Comment** – Update benthic invertebrate diets to account for feeding plasticity (e.g., EPA comment 583)
- **2015 model** – assumed that benthic invertebrate diets were based on primary feeding strategy of group:
  - Deposit feeders = 100% sediment
  - Detritivores = 100% detritus (i.e., fluff)
  - Carnivore/omnivores = 100% other invertebrates
- But in reality, invertebrates have a primary feeding strategy, as well as other alternate feeding strategies.

Benthic Invertebrates:
Diet of Example Detritivore (2015 model)



Benthic Invertebrates:
Diet of Example Detritivore (updated model)



Benthic Invertebrates:
Sediment Exposure Depth

- **EPA comment:** Update exposure depth to 15 cm, rather than 2 cm depth (e.g., EPA comment 571).
- **Model revisions**:
  - Literature indicates higher exposure to surface layers.
  - Considering use of literature-based range of weighting factors for deposit feeding invertebrates:

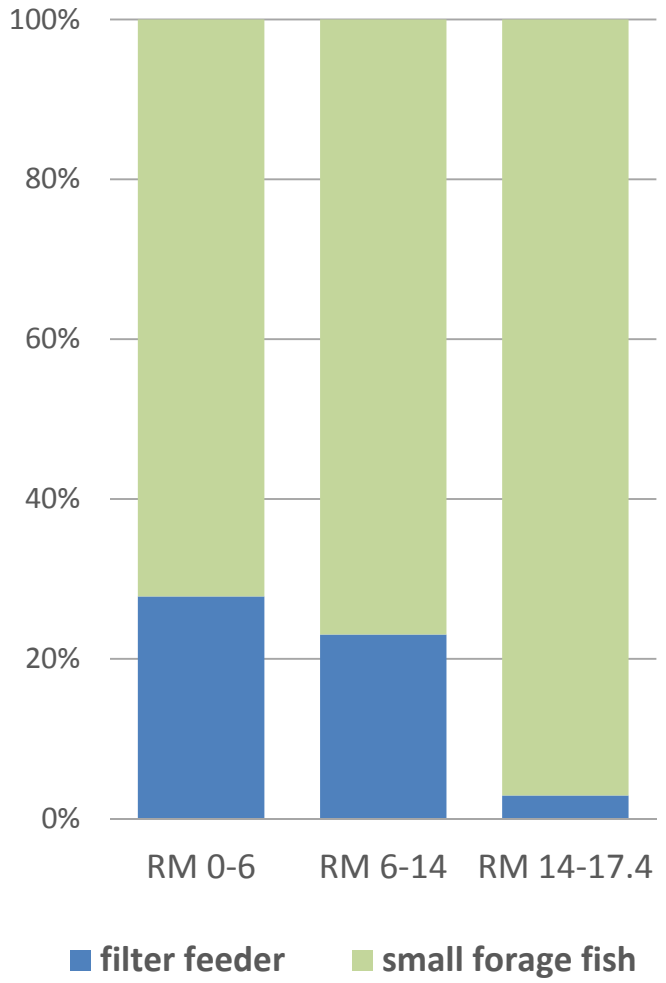
Depth Horizon	Sediment Depth-Weighting Factors by Modeling Area		
	RM 0 to 6	RM 6 to 14	RM 14 to 17.4
0 – 2 cm	39 – 95%	39 – 99%	99%
2 – 5 cm	12 – 33%	1 – 33%	1%
5 – 10 cm	1 – 28%	< 1 – 28%	<1%
> 10 cm	< 1 – 18%	< 1%	<1%

Diets for upper trophic level species

- **EPA comments**:
  - Consider abundance of small fish in development of diets (e.g., EPA comments 384, 585).
  - Improve rationale for when diets based on abundance (e.g., EPA comment 585).
- **Model updates:**
  - Added more rationale to report for when using abundance data to develop diets vs. when diets are influenced more by feeding habits of modeled species.

Diets for upper trophic level species
(continued…)

- **Model updates**:
  - Updated small fish component of diet to use abundance of small forage fish vs. filter feeding fish to inform diets
    - LPRSA data and sampling methodology
    - Ongoing literature search
    - Incorporation of small eel
  - Updated diets to vary by modeling segment



Removal of Particulate Ventilation Rate Constant

- **EPA comments**: Recalibrate model without particulate ventilation rate constant and add exposure of carp to deeper sediments (e.g., EPA comments 569, 578, 591).

- **Model updates**:
  - Carp ventilation constant removed from model.
  - Incorporated exposure of carp to deeper sediments (up to 15 cm). As with benthic invertebrates, working to develop weighting factors for exposure depths.

Model Calibration

- **Updates that will be incorporated**:
  - Change CFT model inputs to use 2009/2010 data for consistency of calibration period with tissue sample collection (e.g., EPA comments 586, 588).
  - Evaluate revised river segments and smaller areas (to the extent that the available data supports this) (e.g., EPA comments 574, 577). As part of this, consider size of typical foraging area / home range for each modeled species.
  - Compare benthic invertebrate concentrations to expected BSAFs (e.g., EPA comments 575, 590, 595).
  - Consider variability in benthic biomass across seasons and locations (e.g., EPA comment 614).

Model Calibration (continued…)

- **Updates that cannot be fully incorporated:**
  - Incorporate time-series tissue data into model calibration (e.g., EPA comment 588). Sufficient time series data are not available for the LPRSA at this time; may be possible in future work.
  - Consider other species in calibration (particularly small forage fish) (e.g., EPA comments 587, 594, 596). This will be done to the extent that empirical data are sufficiently representative.

- These items will be addressed as part of uncertainty and/or sensitivity analysis if not fully incorporated into calibration.

Sensitivity Analysis

- Revised report will consider whether alternative calibrations could be used, assuming that these alternative calibrations are of similar quality and hold up to verification for multiple chemicals and species (e.g., EPA comments 571, 607).
- Single parameter analyses will be removed (e.g., EPA comments 598, 599).

Other minor updates

- **Growth rate equation** – Updated growth rate equation per EPA comment to be continuous relative to temperature rather than step-wise (e.g., EPA comment 605).
- **American eel** – Split eel into large (> 50 cm) and small (< 50 cm) compartments in the updated model (e.g., EPA comment 604).
- **Model format** – Changed model format from Excel-based VBA code to R script to allow for increased model complexity.

Other Topics:

FWM Peer Review, Newark Bay Modeling, and Schedule/Next Steps

Peer Review for FWM

- What can we do to help?
- What type of documentation needed?
- Expected process and timeline?
  - Part of EPA review process?

Bioaccumulation Model for Newark Bay

- Consistency of modeling framework and general CSM?
- Available data?
- Deliverable and documentation?
- Schedule?

Schedule/Next Steps

- On-track with bioaccumulation model updates for the LPRSA.
- Schedule:

Calibrated model	Ready approximately 2 months after receipt of EPA-approved calibrated CFT model results.
Report	Ready approximately 3 months after receipt of EPA-approved calibrated CFT model results.

- Next steps?
- Future meetings needed?